

REMARKS/ARGUMENTS

In response to the Office Action mailed October 18, 2005 Applicants amend their application and request reconsideration. No claims are added or cancelled so that claims 1-20 remain pending.

The Examiner objected to the specification because of a typographical error at page 4 that is corrected in this Amendment.

Claims 9-12 were objected to because of an error in twice referring to film-forming materials. Clearly, it was intended to refer to purging of the oxidants in the penultimate paragraph of claim 9. An inadvertent error that occurred in the preparation of the Preliminary Amendment is corrected here, overcoming the objection to claims 9-12.

Claims 17-20 were rejected as indefinite based upon language appearing in claim 17. In this Amendment, claim 17 has been made dependent from claim 1. The limitation of amended claim 17 that remains is supported by the description in the patent application with regard to the fifth embodiment appearing at page 12 of the patent application. Applicants do not agree that claim 17 was or is narrative in nature and, therefore, request the withdrawal of the rejection.

In this Amendment formerly independent claims 13 and 17 have been rewritten as dependent claims depending from claim 1. The remaining independent claims are claims 1, 5, and 9. Those claims have been amended for clarity. The steps of the methods described in those claims are arranged more sequentially than in the examined claims by placing the step of forming the gate electrode at the end of the claims. The gate electrode cannot be formed until after the second insulating film is formed since the gate electrode is formed on that second insulating film. Further, the description of the formation of the second insulating film in repeated and continuous cycles is mentioned before the description of the four steps that constitute each cycle, in an attempt to clarify the claims. None of the independent claims have been substantively amended.

In the method according to claim 1, in forming the second insulating film, in each cycle, film-forming materials are supplied, film-forming materials that have not been adsorbed by the first insulating film are purged, oxidants are supplied to the adsorbed

film-forming materials to form an oxide, and the oxidants that have not contributed to the oxidation are purged. An important feature of the invention, clearly explained in the patent application and supported by experimental results showing that insulating films of improved quality are produced, involves in forming the second insulating film, purging the oxidants in initial cycles of the process for a longer time than purging oxidants in subsequent cycles of the process of depositing the second insulating film.

In the method according to claim 5, the method likewise includes using longer purging times in initial cycles of forming the second insulating film than in subsequent cycles. However, rather than purging the oxidants, in the method according to claim 5, it is the film-forming materials that are purged for longer times in the initial cycles than in the subsequent cycles.

The method according to claim 9 combines both of the features of claims 1 and 5 providing that purging times for both oxidants and film-forming materials are longer in initial cycles than in subsequent cycles of the process of forming the second insulating film.

Claim 13, which has been made a dependent claim depending from claim 1, also specifies that a larger quantity of the oxidants are supplied in the initial cycles than in the subsequent cycles of forming the second insulating film. Claim 17, now a dependent claim depending from claim 1, likewise specifies that the supply of the oxidants is controlled in separate cycles, within the initial cycles. There are a larger number of the initial cycles than in the subsequent cycles that, together, are carried out in forming the second insulating film.

Claims 1-20 were commonly rejected as obvious over Ahn et al. (Published U.S. Patent Application 2004/0175882, hereinafter Ahn) in view of Chang et al. (U.S. Patent 6,884,719, hereinafter Chang). This rejection is respectfully traversed.

Ahn describes a process involving atomic layer deposition (ALD), in which alternating atomic layers of a metal and of the metal oxide are deposited. According to the process of Figure 4 of Chang, to which the Examiner directed attention, a plurality of atomic layers of a metal, namely hafnium, are deposited as a single atomic layer of hafnium, followed by depositing a number of atomic layers of hafnium oxide. Clearly,

since the hafnium layer is an electrical conductor, it cannot qualify as either the first or the second insulating film of the method claimed in the present patent application.

The Examiner has relied upon the natural formation on a silicon substrate of a native oxide as corresponding to the forming of the first insulating film according to the invention. This comparison is inappropriate because it assumes that, according to the Office Action, that there is no cleaning process. However, paragraph [0062] of Ahn clearly describes the cleaning of a silicon substrate with HF before beginning the process illustrated Figure 4 of the patent application. Those of skill in the art recognize that HF removes the native oxide film from silicon. The other substrates mentioned by Ahn do not develop native oxides and therefore no cleaning step is required or described by Ahn.

The comparison of the examined claims to Ahn is incorrect. The Examiner has assumed the absence of a step in Ahn that is clearly employed by Ahn and described as essential in processing a substrate that forms a native oxide. Because of that error, there is no description in the prior art relied upon with regard to forming the first insulating film, a step of each of the pending claims. On that ground alone, the rejection should be withdrawn.

The Examiner relied upon steps 430-450 of Figure 4 of Ahn as describing the cyclic formation of the second of the second insulating film. This comparison seems correct with the exception of any discussion in Ahn of varying any purging times in different cycles, with longer purging times being employed in initial cycles than in later cycles. This failure of Ahn is acknowledged at page 4 of the patent application. In order to supply this element of the claimed invention, reliance was placed upon Chang. However, the reliance on Chang is incorrect because Chang is being interpreted in light of the disclosed invention, not in light of the disclosure of Ahn and Chang considered by themselves.

According to the Office Action, reliance was placed upon Chang in the passage from column 9, line 66 through column 10, line 14. This passage of Chang merely states that the

“‘deposition conditions’ (i.e., conditions for the time period in which the gas precursor is allowed to contact the substrate) of one or more [of] the reaction cycles can be controlled. In some

embodiments, for example, it may be desired to utilize a certain preselected deposition temperature profile, gas precursor vapor pressure profile, deposition time profile, and/or gas precursor flow rate profile so that one reaction cycle operates at one set of deposition conditions, while another reaction cycle operates at another set of deposition conditions.”

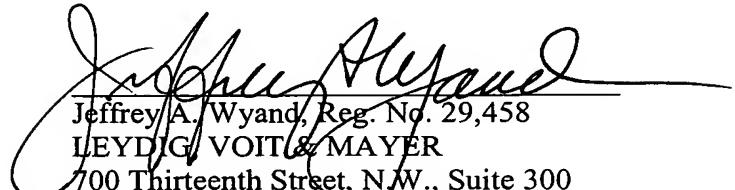
The foregoing passage of Chang merely states that one can vary conditions between reaction cycles. There is no description in that passage that one should provide longer periods of purging film-forming materials in the initial cycles of deposition of a film and shorter periods in latter cycles of the film deposition. Likewise, there is an absence of any reference to making an initial group of purging cycles longer than a subsequent group of purging cycles. Chang certainly invites a person to experiment but does not point in any direction and particularly not in the direction of the claimed invention as defined by the three independent claims and, thereby, by their respective dependent claims.

The assertion at page 4 of the Office Action that Chang would have made it obvious to use longer purging times either for film-forming materials or for oxidants during initial cycles, as opposed to later cycles, can only be based upon the Examiner’s knowledge of the invention as disclosed in the present patent application. No such motivation can be found, as asserted, in Chang at column 10, lines 53-64. That passage has nothing to do with purging steps but only with oxidant supplying steps of the cycle. Thus, the rejection is clearly erroneous and must be withdrawn as to all claims now pending.

Claims 2-4, 7, 8, and 10-20 all depend from one of claims 1, 5, and 9. Because *prima facie* obviousness has not been established with regard to claims 1, 5, and 9, there is no necessity of discussing the remainder of the points of rejection in the Office Action. Even if one of Ahn of Chang should supply any of those limitations of the dependent claims, because of their failure to suggest the independent claims, the combination cannot suggest any of the dependent claims.

Reconsideration and prompt issuance of a Notice of Allowance are earnestly solicited.

Respectfully submitted,



Jeffrey A. Wyand, Reg. No. 29,458
LEYDIG VOIT & MAYER
700 Thirteenth Street, N.W., Suite 300
Washington, DC 20005-3960
(202) 737-6770 (telephone)
(202) 737-6776 (facsimile)

Date: January 10, 2006
JAW:ves

